

# Improved Design of Radiation Hardened, Wide-Temperature Analog and Mixed-Signal Electronics, Phase I

Completed Technology Project (2010 - 2010)



## Project Introduction

NASA space exploration projects require avionic systems, components, and controllers that are capable of operating in the extreme temperature and radiation environments of deep space. To design wide-temperature radiation-hardened (rad-hard) electronics and predict characteristics and reliability in space, advanced models and simulation tools are required at multiple levels. Analog and mixed-signal circuits for space have not been adequately addressed so far. This project aims to design, develop, validate, and demonstrate novel Radiation Hardened By Design (RHBD) analog/mixed-signal integrated circuits (ICs) aimed for the extreme environments of space. In Phase 1, CFDRRC in collaboration with Georgia Tech will: (1) enhance and demonstrate the CFDRRC's unique physics-based mixed-mode simulation tools (NanoTCAD coupled with Cadence Spectre) for predicting extreme-wide-temperature and transient radiation response of analog/mixed-signal ICs based on silicon-germanium (SiGe) BiCMOS technologies; (2) perform first-ever mixed-mode simulation-based investigation of single-event effects (SEE) in SiGe analog, mixed-signal, and radio-frequency (RF) circuits in wide temperature range, and provide important understanding of currently unexplained physical phenomena behind the experimental radiation/temperature data collected under the NASA Exploration Technology Development Program (ETDP); and (3) develop preliminary RHBD concepts for SEE hardening. In Phase 2, we will demonstrate and validate the improved physics-based models for temperature range from -230

o

C to +130

o

C, and apply them to evaluate and develop RHBD designs over the expected operating range. New RHBD devices and analog circuits will be fabricated in prototype chips and tested at wide temperatures and radiation, and delivered as a component library to NASA.



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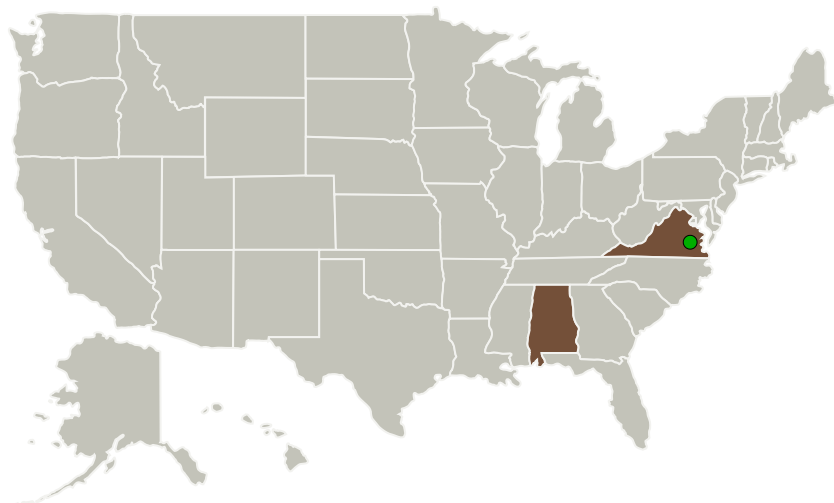
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

## Primary U.S. Work Locations

Alabama	Virginia
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## Project Transitions

**January 2010:** Project Start

**July 2010:** Closed out

## Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140061>)

## Organizational Responsibility

## Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

## Lead Organization:

CFD Research Corporation

## Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

## Program Director:

Jason L Kessler

## Program Manager:

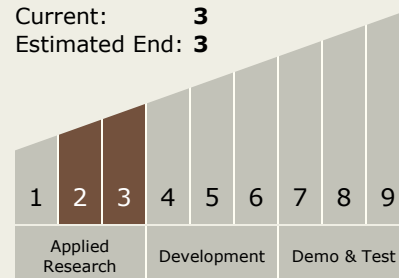
Carlos Torrez

## Principal Investigator:

Marek Turowski

## Technology Maturity (TRL)

Start: **2**  
 Current: **3**  
 Estimated End: **3**



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## Technology Areas

### Primary:

- TX10 Autonomous Systems
  - └ TX10.3 Collaboration and Interaction
    - └ TX10.3.4 Operational Trust Building

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System